Field of the invention

The present invention relates to a procedure and a telecommunication system which enhances utilizing mobile telephone services in non-mobile telecommunication networks.

Background of the invention

There is known a technology of using one and the same personal telephone number recognizable in different telecommunications networks. For example, EP 0738093 A2 (to TELIA AB), which is incorporated herein by reference, describes the technology where one telephone number is associated with a subscriber in various different communications networks. A condition for using this personal number is a central network node located at or being in communication with the mentioned different networks, preferably PSTN, ISDN, GSM or other mobile networks such as NMT (Nordic Mobile Telephony). The central network node does not influence network functions, numbering schemes and terminals in these networks. When a call is directed to a subscriber associated with any of the mentioned telecommunications network or utilizing a cordless access system, the call (independent of which telecommunications network it emanates) is connected to this central network node which converts the received personal number to the specific number corresponding to the communications network at which the subscriber has registered himself/herself. Upon that conversion, the network node connects the call to the current access point which corresponds to the specific number.

Also, there is known a US patent 6,301,474 (to Openwave Technologies Inc.) which is incorporated hereby by reference, describing a mobility extended telecommunication application. The technology comprises an integrated wireless and wirelined network with central

control, which has a programmed interface to translate between the different protocols of the wireless and the wirelined networks to allow for automatic redirection of a new incoming call, that is about to be established, between a telephone device of the wireless network and a telephone device of the wireline network.

The services proposed in the above patent publications are quite advanced. However, every user who intensively uses the phone , often encounters the situation when a conversation starts while using a fixed or cordless phone but, since the user must leave the premises, the conversation has to be stopped and, upon redialing, to be continued from a mobile phone. The users are also familiar with an opposite situation, when a communication session starts at a mobile phone and after a period of time could have been continued at a fixed or cordless phone (e.g. while obtaining a higher quality of service and/or while using more comfortable appliances at the premises), but the cumbersome operation of disconnecting and re-connecting prevents the user from making that switch.

There are also many other situations where a user of a mobile network (who is also a user of a non-mobile network) would be interested of transparently using features of the non-mobile network and features of the mobile network whenever desired.

Summary of the invention

The objects of the present invention, among which resolving the problems outlined above, will be explained as the description of the invention proceeds.

There is proposed a method for supporting telecommunication sessions with participation of a non-mobile telephone number assigned to a non-mobile device in a non-mobile access network or a mobile

Exhibit AA

telephone number assigned to a mobile device in a mobile network, wherein both of the numbers are registered to one user (or a number of associated users), the method comprises

providing an access device operatively connected with said non-mobile access network and routinely serving said non-mobile device in said non-mobile access network,

connecting said access device with a fixed controller of said mobile network for supporting bi-directional signaling and telecommunication sessions there-between,

providing said access device with a capability of transforming communication protocols from at least one protocol of said mobile network to at least one protocol of said non-mobile network and vice versa,

associating said mobile number with said non-mobile number in said access device,

providing to said access device functionality similar to that of a base station (node B) of said mobile network, said functionality including at least

monitoring and processing signaling sessions with respect to said non-mobile device having the non-mobile number and with respect to said mobile device having the mobile number and,(based on that,)

determining location of said mobile device with respect to said non-mobile network,

thereby supporting communication sessions of said user in a combined communications network comprising said non-mobile network and said mobile network, in a manner enabling versatile use of

said non-mobile device and said mobile device *(can they be used together, too? say, in parallel?).*

The access non-mobile network can be, for example, a fixed PSTN (Plain Service Telephone Network), a wireless LAN (Local Area Network), etc. The mobile network should be understood as a cellular network.

Preferably, the method comprises connecting the access device via wireline means both to the access non-mobile network and to the fixed controller of the mobile network.

The access device can be in the form of a DSLAM (Digital Service Line Access Multiplexer), a DSLAM in combination with a CPE (Customer Premises Equipment), a CO (Central Office - Can be?); in these cases the wireline means connecting the access device with the non-mobile communication network will be in the form of DSL or xDSL lines.

Alternatively, the access device can be in the form of OLT (Optical Line Termination), wherein the wireline means between the access device and the non-mobile access network are in the form of one or more optical fibers.

The fixed controller of the mobile network may, for example, be a radio network controller RNC, ***located at a fixed "central office" of a cellular network).***

Alternatively, it can be an IMS utilizing SIP Proxy. (IP Multimedia Subsystem -OK? Interactive Management System?) The IMS preferably comprises a SIP Proxy Server of Session Initiating Protocol for Real-time Transport Protocol (RTP). (OK? Why it is better than RNC for the method?)

The first number of the non-mobile device and the second number of the mobile device may optionally be one and the same number. (OK?)

The method turns the non-mobile network to become a part of the mobile network and allows performing a variety of new communication options in such a combined communications network.

For example, the non-mobile device having the first number can be used in parallel with the mobile device having the second telephone number (NO? I.e., the routing cannot be doubled? And if they have the same number?)

Another example is rerouting an incoming communication session directed to the non-mobile device, which is currently busy, to the mobile device (or vice versa). (It seems to be known , isn't it?)

Yet another example is transferring a communication session in progress from the non-mobile device to the mobile device, and vice versa.

In other words, by an embodiment of the present invention there is provided a method for supporting re-routing, during a single communication session, from the mobile device (e.g. a cellular telephone and the like) associated with the mobile communications network to the non-mobile device (e.g. a desk telephone, a cordless telephone and the like, a computer, etc.) associated with the non-mobile communications network, or vice versa,.

The above method further comprises the following steps performed under control of said access device:

obtaining , from at least one of said non-mobile device and said mobile device, a suggestion of re-routing of a communication session being in progress on one of said devices, to be held via the other device;

re-routing the communication session that is currently in progress and routed to one of said mobile and non-mobile devices, to the other of said mobile and non-mobile devices, *upon approving the rerouting.*

In practice, the rerouting step can be performed as follows:

if the communication session is currently in progress and routed to said mobile device via a current communication path terminating with a suitable section of said mobile network, rerouting said session to said non-mobile device via the same communication path wherein the termination portion is replaced with a section of the non-mobile communications network;

if the communication session is currently in progress and routed to said non-mobile device via a current communication path terminating with a suitable section of said non-mobile network, rerouting said session to said mobile device via the same communication path wherein the termination portion is replaced with a section of the mobile communications network.

In the simplest case, the communication session is a telephone call. However, both the mobile device and the non-mobile communication devices may provide not only voice sessions, but ensure fax transmissions, data communications, multimedia sessions. It means that the mobile communication device can be a personal computer having a cellular connection to internet, a mobile phone with the fax and internet functionality, etc.

In the preferred version of the method, the step of obtaining a suggestion of the rerouting comprises obtaining indication that the non-mobile device and the mobile device are located within a geographical proximity within the area of said non-mobile network, comfortable for the rerouting and changing the active device.

The step of obtaining a suggestion of the rerouting may comprise various sub-steps (regardless whether there is or there is no geographical proximity between the devices): for example, it usually comprises an initial signaling message issued by one of said mobile device and non-mobile device to said access device, such a signaling message actually being a suggestion to perform the rerouting. The message may either inform on the automatically detected proximity between the devices, or be just a request of rerouting initiated by the user from one of the devices.

The above-mentioned options can be explained using the following examples.

By one embodiment, the mobile and non-mobile device have a common receiver adapted to be used as a non-mobile device when in proximity with a base part of a cordless phone (e.g. one that is adapted to operate in a Digital European Cordless Telecommunication -DECT- network), while said receiver is also adapted to be used as a mobile device when remote from the base part of the cordless phone.

In this embodiment, determining of the proximity can automatically be performed by the base part of the cordless phone, and *will also comprise an appropriate signaling message issued by said base part and directed to said access device*. However, the cordless telephone device may act differently, i.e. without automatically determining the proximity, and similar to fully separated mobile and non-mobile devices.

In another, preferred embodiment, the non-mobile device is a communication device associated with a non-mobile network (such as a cordless phone, a fixed digital (only?) telephone in a wireline network, a wireless phone/computer in a wireless network), and the mobile device is a cellular communication device (such as a cellular telephone fully

separate from the non-mobile device) associated with the mobile (cellular) network.

In this case, *the step of obtaining a suggestion of the rerouting (in a specific case, the step of determining said proximity between the mobile and non-mobile devices)* is ensured by a user during the communication session, *by initiating a signaling session to request the rerouting from the access device.*

The request of rerouting is preferably applied from the device presently *not engaged* with the communication session and results in revealing (i.e., comprises implicitly or explicitly) information on the number of the device to which the rerouting is requested. In one embodiment of the method, the *access device* may store information on a group of non-mobile devices and mobile devices that are pair-wise entitled for rerouting communication sessions there-between.

Preferably, the method described above further comprises a step where, upon carrying the readiness determining step, the user presently engaged in the communication session via one of said devices receives an indication that he/she may switch to the other device. Still preferably, the re-routing step is carried out following a response received from the user to that indication.

According to another aspect of the invention, there is proposed an access device having features enabling performance of the above method.

In particular, there is proposed an access device capable of supporting communications sessions in a combined network comprising an access non-mobile network and a mobile network, wherein

the access device being wireline connectable both with said non-mobile access network and with a fixed controller of said mobile network to enable digital communication,

the access device being capable of transforming communication protocols from at least one protocol of said mobile network to at least one protocol of said non-mobile network, and vice versa,

the access device being provided with a functional unit performing functions similar to that of a base station of said mobile network, including:

registering at the access device at least one mobile telephone number assigned to a mobile device in said mobile network,

monitoring and processing signaling sessions and communications sessions associated with said mobile telephone number,

determining location of the mobile device associated with said registered mobile telephone number, with respect to said non-mobile network.

Preferably, the access device is further adapted for

registering said mobile telephone number with association to at least one non-mobile telephone number assigned in said non-mobile network to a non-mobile device,

monitoring and processing signaling sessions and communications sessions of said non-mobile telephone number,

enabling versatile use of said mobile and non-mobile devices in the combined communications network, based on said monitoring and processing of the signaling and the communication sessions of said non-mobile and said mobile telephone numbers.

Preferably, said mobile number and said non-mobile number are assigned to one user or a number of associated users.

According to a preferred embodiment of the access device, it is further adapted to support rerouting of a communication session when in progress via said non-mobile device of the non-mobile network, to said mobile device of the mobile network and/or vice versa.

Preferably, the access device is capable of initiating said rerouting based on the monitoring and the processing of said signaling sessions, for example upon receiving a signaling message being a rerouting request and/or upon receiving a signaling message that said two devices are in proximity to one another.

The access device preferably comprises a DSLAM (Digital Signal Line Access Multiplexer) routinely serving said non-mobile network by supporting protocol(s) of the non-mobile network, and the functional block constituting a hardware/software means and a memory means (one or more cards) enabling the DSLAM to perform all the above-mentioned new capabilities and functionalities. It should be noted that in a particular embodiment, the access device may constitute a DSLAM in combination with a modified Customer Premises Device (CPE) serving a specific local network as part of the access network; in this case the hardware/software means can be distributed between the CPE and the DSLAM. For example, the protocol transforming block can be located at the CPE.

Alternatively, the access device can be in the form of an enhanced OLTI.

According to yet a further aspect of the invention, there is provided a system operative to support a communication session in a combined network, the system comprising

at least one access device as described above,

at least one non-mobile communication network connected to said access device by wireline means and associated with at least one non-mobile communication device, and

at least one mobile communications network associated with at least one mobile communication device and having a fixed controller of the mobile network connected to said access device by wireline means and operative to establish digital communication with said access device.

As will be appreciated by those skilled in the art, the non-mobile networks may implement connections to the subscribers by applying one or more various technologies that are currently in use for access networks. Examples of such technologies are POTS (in which case the digital signal received at the edge node device is converted into an analogue POTS signal (**Can be?**), and shall be forwarded to the non-mobile device as such), ATM (where the signal may be forwarded to the non-mobile device as a VoATM signal), DSL (where the signal may be forwarded to the non-mobile device as a VoDSL signal), IP (where the signal may be forwarded to the non-mobile device as a VoIP signal), Bluetooth, UWB, Wimax (**where the signal may be forwarded wireless to the non-mobile wireless phone ??**), and the like.

The non-mobile network may comprise a number of fixed communication devices, one or more cordless communication devices, some of them connected in parallel (for example, a simple desk telephone and a cordless telephone in parallel). In the present specification, the non-

mobile network may comprise at least one Local Area Network (LAN), serving an office, a house, an apartment or the like; it can also be a wireless LAN having a CPE connected to the edge node by wireline means (**OK?**).

The fixed controller of the mobile network may be, for example, an RNC or *an IMS with CSCF comprising a SIP proxy* ((**IP Multimedia Subsystem -OK? Interactive Management System ? The IMS preferably comprises a SIP Proxy Server of Session Initiating Protocol for Real-time Transport Protocol (RTP). (OK? Does using IMS with SIP proxy instead of RNC gives advantages? Please give details).**

Owing to the new functionality of the access device, the non-mobile network actually becomes part of the mobile (cellular) network.

For example, when the communication session is transferred from a mobile device to a non-mobile communication device, the session continues to be transmitted via and supported by the cellular network, as it was made before switching to the non-mobile device, except for the terminating section of the non-mobile network.

Though the user continues using the mobile (cellular) service when switching to a non-mobile network phone, it can be cost effective to both the service providers and the users, due to providing/enjoying the new useful feature.

Brief description of the drawings

The invention will be further described with reference to the following non-limiting drawings, in which:

Fig. 1 is a pictorial representation of one particular example of a communications system implementing the proposed technology.

Fig. 2 presents a simplified block diagram schematically illustrating the proposed principle of interaction between the access device, the fixed controller of the mobile network and the two devices (mobile and non-mobile).

Figs. 3 is a schematic exemplary pictorial diagram illustrating how a communication session in progress can be transferred from a mobile communication device to a non-mobile communication device and vice versa.

Fig. 4 is a schematic flow chart illustrating how a communication session in progress can be transferred from a mobile communication device to a non-mobile communication device.

Fig. 5 is a schematic flow chart illustrating how a communication session in progress can be transferred from a non-mobile communication device to a mobile communication device.

Detailed description of the preferred embodiments

Herein below is a list of acronyms (abbreviations) to be used in the detailed description of the drawings. Some of the important abbreviations are:

CPE (Customer Premises Equipment); RNC(Radio Network Controller); Wi-Fi *(?)*; UE*(a mobile device?)*;
IMS *(……?)* , ….

Fig. 1 illustrates a pictorial diagram of a combined communications networks system. The system comprises a local area network LAN 10 which contains a first private non-mobile network 12 (say, a house network) comprising a cordless phone 14 and a cordless computer 16. Communication sessions to and from the private non-mobile network 12 pass through a CPE (Customer Premises Equipment) 15 located in the

house. The LAN 10 also includes a second non-mobile network 18 **(OK?)** comprising one or more wireless communication devices, such as a computer 20 communicating via a wireless link to an antenna 22 of a wireless local loop system **(OK?)** . Both the CPE 15 and the antenna 22 are connected in a wireline manner (say, via DSL cables/fibers 21 and 23) to a DSLAM 24 of the LAN 10. The DSLAM 24 is an access device and supports protocols of the non-mobile networks 12 and 18; being an edge node between different types of networks, it is designed to support at least a protocol of a mobile communications network 40. Moreover, the DSLAM 24, connected by DSL cables to the private networks 12 and 18, is also connected to an RNC (Radio Network Controller) 42 residing in a fixed "central office" of the mobile network and thus forms a part of the cellular network 40. Fig. 1 shows that the connection between the DSLAM and the RNC is via a wireline link 43 (DSL lines, fiber, etc).

RNC is only one example of a fixed controller means of a mobile (cellular) network. (IMS? -…)

The DSLAM 24 may additionally be connected to other types of networks (say, a fixed network 26 comprising an ATM and IP sub-networks), and therefore constitutes a border node between any pair of the networks associated with it.

According to the invention, the DSLAM 24 (or DSLAM 24 in combination with CPE 15) are embodiments of an access device serving an edge node between a mobile (cellular) network 40 and a non-mobile LAN 10. LAN 10 further comprises the private networks 12 and 18. Let in this drawing the access device is DSLAM 24. The DSLAM 24 has a functionality similar to that of a cellular base station ("Node B") of the mobile network. DSLAM 24 is provided with software and/or hardware means allowing to it maintaining digital communication with RNC 42

(including the signaling and the communication sessions), allocating a mobile device 44 with respect to the access network 10, and serving the mobile device 44, for example by rerouting a communication session from the mobile device to a non-mobile device and vice versa. The mobile device 44 may be located quite far from the LAN, but the communication session can be rerouted if an appropriate signaling information is obtained by the access device 24. Such a signaling information can be applied to the access device by the user, for example to reroute future sessions to another communications device. When routing a communication session from one network to another, the access device should transform communication protocols.

This "quasi" Node B functionality comprises identifying and serving at least some pre-determined cellular telephone numbers, including providing various services characteristic to cellular networks.

The access device is most useful in serving such cellular devices/numbers which are registered in the access device as being respectively associated with particular non-mobile devices/numbers (for example, belonging to one and the same user).

In a case of a common receiver serving both as a mobile device and as part of a non- mobile cordless device, or in a case the cordless device is just the non-mobile device, the function of identifying and allocating the mobile device can be performed automatically, via the base of the cordless device being in communication with the access device. In other cases, these functions are performed based on the signaling received at the edge node from either a non-mobile device (directly), or the mobile device (via its closest base station and then via the fixed controller of the mobile network – say, RNC 42) whenever the rerouting is requested. Serving of the mobile devices is therefore performed by the access device

with the aid of the fixed cellular unit interconnected with it, upon establishing the signaling and communication sessions of the mobile device via the fixed cellular unit of the mobile network.

As has been mentioned, the combined network system further comprises, for example, a fixed network 26 with a routing junction 27. The routing junction 27 performs navigation of data incoming the fixed network 26, either to an ATM –based portion 28 of the fixed network 26 (i.e., the network operating in the format of Asynchronous Transfer Mode), or to an IP portion 30 (the network utilizing Internet Protocol), and vice versa. The cellular network 40 (say, using Asynchronous Transfer Mode - ATM format) may be further connected with networks of other types.

The communication sessions which are considered in the frame of the present patent application are those established along a communication path via a number of different network sections, but including at least a portion in the cellular network 40. For example, the communication path sections which can be exchanged in the process of rerouting according to the invention, are a) a non-mobile network section in the LAN 10 between a particular non-mobile device and the edge node 24 **(OK?)**, and b) a mobile network section in the network 40 between a particular mobile device, its closest base station 46 (controlled by the RNC 42), and the RNC 42.

Since RNC 42 is wireline connected and maintains digital communication with the access device 24, the cellular section of the communication path can be reversibly replaced with a fixed section (section in the access network 10, if so desired).

Fig. 2 presents a simplified block diagram schematically illustrating the proposed principle of interaction between the access device, the fixed controller of the mobile network and the two devices (mobile and non-

mobile) in the basic case of establishing signaling and communication sessions between the two networks.]

Let Fig. 2 illustrates a local access network (LAN) 50 comprising a non-mobile communication device NMD 52. The CPE 53 of the LAN 50 is connected via a fiber 54 to an access device 55 being an Optical Line Termination device (OLT). The OLT is also interconnected, via a cable (or fiber) 56, to a fixed controller 42 of a mobile network 40. A mobile communication device 44 operates in the mobile network 40. Needless to say that communication protocols and signaling protocols of the networks 50 and 40 are different. The connections 54 and 56 allow digital communication to and from the access device 55, including signaling sessions and communication sessions to and from the mobile network and the non-mobile network. For maintaining, monitoring and processing the digital communication, the access device 55 is equipped with a functional unit 58 comprising a memory, a protocols transforming means and a software/hardware block enabling the access device 55 to acquire some functions similar to Node B (base station) of the mobile network 40.

Based on the new functions of the access device 55, MD 44 (if registered in the memory block of the unit 58, can be "sensed" and "allocated" by the access device 55 since the signaling related to the MD 44 is transmitted to the FC 42 and then to OLT 55. If the number of MD 44 is registered in the OLT memory in association with the number of NMD 52 of the network 50 (say, the two numbers belong to one and the same physical or legal user), the OLT may have a further capability of rerouting communication sessions from one device to another. It is understood that the OLT 55 routinely maintains

signaling and communications sessions with the non-mobile network 50.

For example, a new incoming communication call from a cellular telephone 45 is intended for the mobile device 44, but it is currently busy. The OLT access device 55, being up-to-date about the MD 44 which is registered in its memory means, and upon checking that the non-mobile device 52 is active and not busy, may be capable of initiating appropriate signaling to further reroute the incoming session, with the aid of RNC 42, from the MD 44 to the NMD 52. (Isn't it known?) For exchanging the signaling information and the communication data between the two networks 40 and 50, the functional unit 58 of the OLT 55 performs conversion of the communications (and signaling?) protocols.

Another capability of the modified access device, namely the capability of rerouting a communication session in progress, will be described in figures 3, 4 and 5.

Fig. 3 is a simplified exemplary pictorial diagram illustrating rerouting of a communication session, when in progress via a mobile device, to a non-mobile communication device, and vice versa. It should be appreciated that any of the mobile/non-mobile devices, the access device , the fixed controller of the mobile network are shown in their exemplary implementations and may be replaced by other embodiments.

Let us consider Fig. 3 together with Fig. 4, illustrating a simplified flow chart of rerouting a communication session in progress from a mobile device (MD) 44 to a non-mobile device (NMD) 52. In this particular case, the NMD is a cordless telephone device. Suppose the user with the active mobile device MD is in the area of the access non-mobile network 10. The communication session is held between the MD 44

and the destination (not shown) via a communication path (dotted line) passing through the mobile network and terminating with the terminal path I between the NMD 44 and the RNC 42. The presence of the active mobile device in the non-mobile access network will be identified by any suitable means: it can be sensed by the base part of the NMD 52 and further signaled to the access device 24, or just performed by a signaling message sent to the access device 24 by the user (say, from the NMD presently having a free line). That message may comprise the mobile device identification (e.g. its number). The non-mobile device, the mobile device, and/or preferably the access device can be pre-configured with one or more specified devices which can be "inter-switched", so that only communication sessions that are held while using these specified devices, can be re-routed when needed. The access device 24, maintaining exchange of signaling messages with the fixed controller RNC 42 of the mobile network, issues a request of rerouting with respect to the communication session held by the MD 44. RNC which monitors all sessions taking place in the mobile network 40, is capable of checking the possibility and approving the rerouting. The rerouting is performed by interaction of the MD 44, base station 46, RNC 42, DSLAM 24 and the NMD 52 at the signaling level and at the communication level, with changing the communication protocols at the DSLAM 24 and/or CPE 15. Upon rerouting to a non-mobile device NMD, the communication path, instead of the terminal section I, comprises a terminal section II in the non-mobile network, between the NMD, the DSLAM (access device) and the RNC.

The attention is now directed to **Fig. 3** in combination with **Fig. 5.** *Let us consider another case, when the communication session is held via a non-mobile device NMD 52 (shown with a wavy line) and should be*

rerouted to a mobile device presently located remote from the access network. Let, different users, somehow related to one another, hold the two devices. The user holding the NMD 52 signals to the access device 24 about his suggestion to reroute the session, and if there are some options, indicates the number of MD 44. The access device 24, if the number of MD is among the registered ones, opens a signaling session with the RNC to check whether the rerouting to the MD 44 is possible. The RNC, via the base station 46 (and some other base stations, if required), checks the possibility of rerouting the session to the MD 44. The user of the MD 44 may approve or decline the rerouting. Other options exist (say, approval of activating a voice mail or other type of mail boxes). If the approval is obtained, the communication session will finally be rerouted by the RNC under supervision of the access device 24.

As a result, the terminal section II of the initial communication path (the non-mobile section of the communication path) will be replaced with a terminal section I (the mobile section of the communication path).

The access device 24 demonstrates its functionality of the base station by a capability to exchange signaling sessions with the RNC in respect of the mobile numbers registered in the non-mobile network.

In both examples shown in Figs. 3, 4 and 5, in the process of establishing the new communication path, the access device performs a functionality similar to that of "node B" (or functionality of a base station of the mobile network), since while it cannot and does not behave as a base station itself, it is directly interconnected with the mobile network controller and thus imitates the mentioned functionality. (OK?)